EXHIBIT 1

SOS INVESTIGATIONS, INC.
ORIGIN & CAUSE • SURVEILLANCE • ACCIDENT RECONSTRUCTION

INVESTIGATION REPORT

PREPARED FOR:	MR. KEITH YAMAGUCHI ATTORNEY AT LAW KMA ZUCKERT LLC 200 WEST MADISON ST. CHICAGO, ILLINOIS 60606
COURT:	UNITED STATES DISTRICT COURT FOR WESTERN DISTRICT OF OKLAHOMA
PLANTIFFS:	KEVIN HOOG & REBECCA HOOG
CASE NO:	CIV-20-00272-JD
DEFENDANT:	DOMETIC CORPORATION
ADDRESS:	333 S. WESTMINSTER RD., ARCADIA, OK
VEHICLE:	2007 NEWMAR DUTCH STAR 4320
DATE OF LOSS:	FRIDAY, MARCH 30, 2018
CLAIM TYPE:	BUILDING FIRE WITH MOTORHOME
DATE OF INVESTIGATION:	FRIDAY, JUNE 15, 2018
REPORT DATE:	AUGUST 25, 2022
SOS FILE NO:	2018-129-C

SOS Investigations, Inc.
INVESTIGATION REPORT

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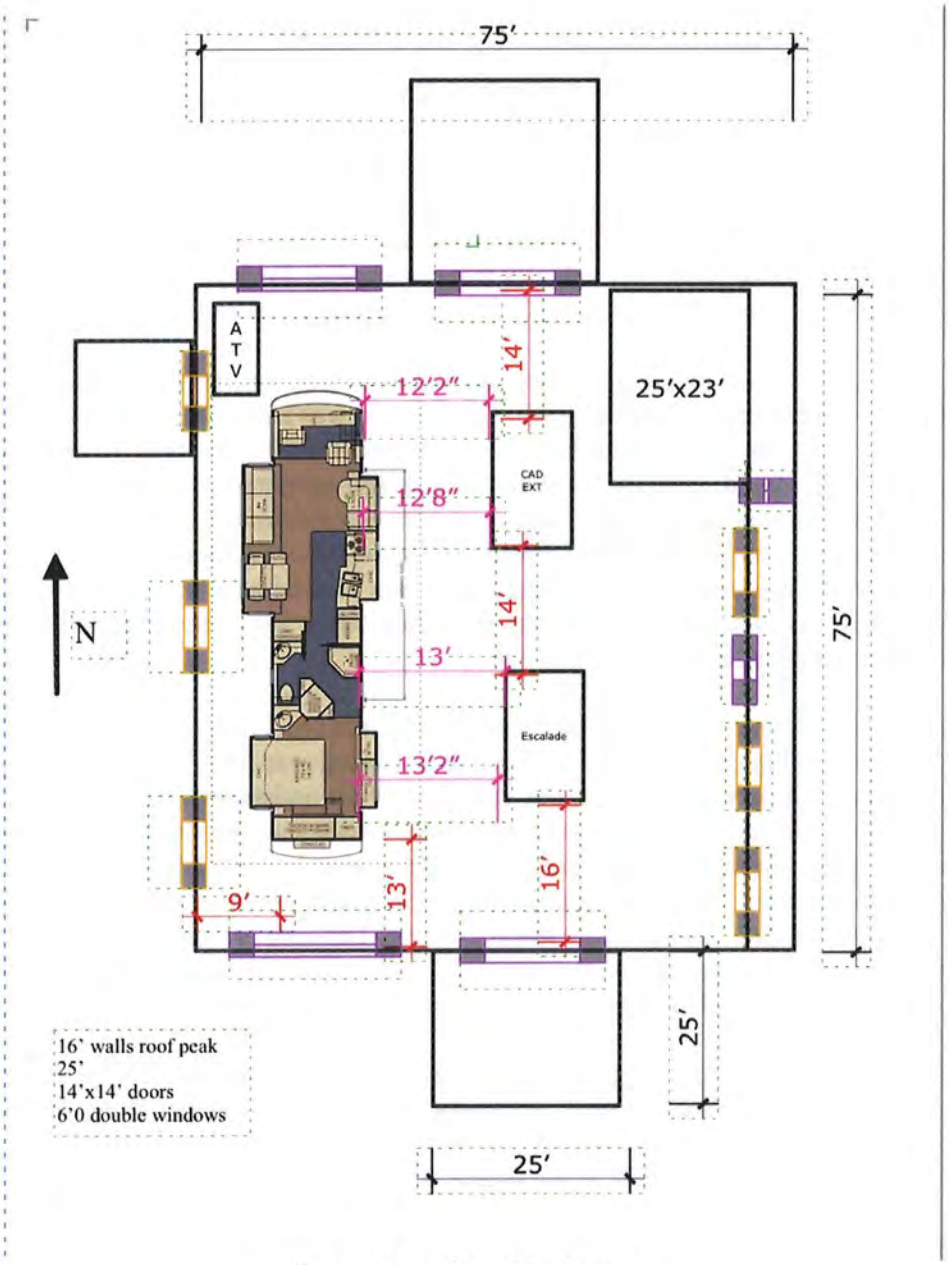

Floor Plan of the RV Garage
Not to Scale. Front porch is 10' deep.

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This report is accompanied by a collection of the photos that illustrate the contents of the report. The photo attachment should be used when reading the report to provide a graphic understanding.

SUMMARY

On Monday, May 14, 2018, this investigator was contacted by Mr. Ben T. White, II Assistant General Counsel, of Dometic Corporation and requested to conduct an origin and cause investigation of a building fire at 333 S. Westminster Rd., Arcadia, Oklahoma, which included a recreational vehicle and two passenger vehicles that occurred on Friday, March 30, 2018. The RV involved was a 2007 Newmar Dutch Star 4320 that belonged to Mr. and Mrs. Kevin Hoog.

On Friday, June 15, 2018 this investigator traveled to 333 S. Westminster Rd., Arcadia, Oklahoma to take part in the examination of the fire loss. The fire loss was a large metal frame building with metal exterior, a brick band along the base of the exterior walls that was located behind the residence and behind a pond. The building had double roll-up garage doors on the south end of the building and two similar doors on the north end. The east side of the building had a pedestrian entrance and windows facing the pond all covered by a ten-foot-deep porch that ran the length of the building. A small attached enclosed storage area was located near the north end of the west exterior wall. This area housed various items including some lawn care equipment and an air compressor. The room was wired for further items.

Examination of the exterior of the building found the electrical service entrance was located to the east side of the east rollup door. Evidence of electrical arcing was found in the electrical service entrance. The electrical service entrance was supplied by an underground service that entered a metal enclosure in the location described and then connected to the distribution equipment located on the interior of the same wall. The service entrance was located adjacent to the electrical distribution on the interior wall. The examination of this area found some discoloration of the bricks and concrete and fire damage to the metal exterior. The area in front of the roll-up door had been partially cleaned up. Spalling of the concrete in the area was noted and the observations indicated combustible materials had burned in the area adjacent to the electrical service entrance.

The RV was located parallel to the middle of the west wall of the building. The power outlet that supplied the RV was located on this wall. A variety of items were located along the base of the wall, which will be discussed in the report. The items along the wall were not involved in the causation of the fire but did contribute to the degree of damage to the west wall.

The examination of the interior of the building found rows of lights mounted north to south along the ceiling along with a gas supplied heating system. The living space (apartment) was in the northeast corner of the building. The multi-room apartment suffered damage from fire attack. The apartment was a stick-built structure finished with painted gypsum board. The examination of the

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apartment determined the fire did not originate in the apartment, but the bank of cabinets attached to the exterior wall added to the fuel load in the first interior areas of the building to become involved in the fire. The damage to the apartment was mostly caused by the heat flux from the thermal layer at the roof and the subsequent involvement of the Cadillac EXT that was parked parallel to the west wall of the apartment.

Hoog Client Photos -_0010.jpg view from northwest corner

The electrical service entered the building from an outside panel at the northeast corner of the apartment. Fire damage/spread patterns and arc mapping indicated the fire originated in the area where the electrical service entrance was located and spread into the building via the path into the electrical distribution panel. This area was located adjacent to a storage area, which included a series of cabinets that were mounted to the exterior wall of the apartment and into the area between the apartment wall and the exterior wall of the building. The wall was finished with painted gypsum board with the cabinets attached and containing various items. The cabinets and the items inside would be fuel for the fire as it moved toward the south along the west wall of the apartment from the area of the north wall of the building and the north end of the apartment's west wall.

Hoog Client Photos -_0016.jpg view from east side of building

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The RV was the largest fuel load in the building. Its proximity to the west wall was the cause of the damage to the interior of the west wall and to the structural components above. The extensive damage in this area does not indicate the area of fire origin but only the location of the greatest heat generated based on the amount of fuels present in the area. The RV was not the only fuel source in the area. Several propane bottles were located on rack storage along the west wall of the building. Areas of greater damage require extra attention and consideration. This consideration should include an estimate of the amount of BTU's generated in the area allowing a comparison of the expected damage to the actual damage. In this case the combination of the fuel related to the RV and the additional fuel packages along the west wall combined to create the area of greatest damage. The fuel package related to the RV includes but is not limited to the following: propane in the onboard storage tank (approximately 80-gallon tank), the diesel fuel in the onboard storage tank (approximately 250 to 300-gallon tank), furnishings and finishings in the coach, the six tires on the coach and various other items normally found in a recreational vehicle needed by the users while camping. The items gathered normally continue to increase as the coach is used, as each trip is an adventure that generates stuff and every activity sheds light on needing something else to make the adventure more comfortable. We were not provided a contents list for the coach. The fire spread to the coach after the Cadillac and the east garage door on the north wall became involved in the fire.

Hoog Client Photos IMG_0010 annotated .jpeg

Several other hypotheses of fire origin were considered and excluded. The only hypotheses that could not be completely excluded was the fire originating around the electrical service entrance on the exterior of the building. The area of the electrical service entrance and the areas immediately adjacent to it had electrical evidence supporting the fire originating in this area, but no evidence of electrical activity on any circuits in the building. Examination of the electrical distribution system in the building found no confirmed evidence of electrical activity on the branch circuits during the examination of the circuits while in place in the building, during collection from the building and, in the electrical distribution panel. The collection of the circuits included marking the circuits with both colored tape and zip ties to identify the circuits, the location of cuts and location of the circuits during the lab exam if evidence of arcing was found. The wiring was then

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collected and examined in a lab setting. The lab examination identified some areas of interest but no areas of confirmed electrical activity. The analysis of the locations of suspicion found no evidence of arcing. Evidence of eutectic melting was found in some areas along with areas of fracture of the wiring in other areas. Due to the origin of the fire being at the electrical service entrance no evidence of electrical activity should be possible as this arcing event would have caused the pole top fuse to open on the circuit supplying building.

The examination of the two passenger vehicles in the building could not exclude them based on the examination solely of the fire damage. The amount of damage to the two Cadillacs was extensive, which resulted in the melting of numerous electrical conductors and destruction of most of the combustible materials. The Cadillacs were both located in areas in proximity to the coach and other fuel packages. Fire spread to these other fuel packages was possible from other locations. The examination found the fire originating in the electrical service entrance was the most probable area of fire origin and was supported by evidence of electrical arcing in the service entrance. Lack of arcing in the electrical distribution panel excluded the Cadillac as being the source of the fire. If the fire originated in the Cadillac EXT, the electrical panel would have been energized when attacked. The breakers may have tripped due to heat, but the feeder circuit would have been energized and arced to the metal panel.

2007 Newmar Dutch Star 4320 Floor Plan

Examination of the 2007 Newmar Dutch Star 4320 found the RV burned to near completion. The examination of the RV included the examination of the electrical supply to the RV and the path that supply took. The electrical circuits routed on the same path as the circuit for the RV were collected and examined in a lab setting. There was no evidence of arcing on the circuits caused by either fire attack or failure. The coach was located nine feet from the west wall of the building

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and just under 14' from the north wall and 13' from the south wall. The coach was located 12'8" from the Cadillac EXT and 13'2" from the Cadillac Escalade.

The proximity of the coach to the west wall and the routing of the wiring on the north and west walls, would have exposed the circuits to fire attack as the fire grew in the coach and the building assuming the fire originated in the coach. The circuit supplying the coach had no evidence of being energized when the fire attacked the circuit, consistent with all the other circuits following the same path also not having evidence of being energized. The lack of electrical activity on the circuits supplying the coach and the north and west wall indicated either the breaker tripped due to an event in the coach, or the power was interrupted by the event near the source of the power. The examination of the electrical supply to the coach found it was not continuous to the coach and the coach was not being supplied with 120 VAC power.

The circuit was continuous to the RV outlet inset in the west wall. Evidence of an RV extension cord was found on the floor below the outlet. The RV extension cord was traced from the west wall toward the RV. The female end of the extension cord was found short of the side of the coach as illustrated in photograph 549. The cord appeared to be rolled up and hung or placed on the south rack storage, which was closest to the RV outlet in the west wall.

The excavation continued into the coach. The coach has a notch in the frame to allow the shore cord to exit the compartment with the door closed as illustrated in photographs 679-683. The shore cord's male plug pins were found near the shore cord storage compartment door where the cord is stored. The male plug was stored inside the cord compartment with the door closed. The door had come loose at the hinge from the coach and fallen onto the floor with the male plug pins next to the compartment door as shown in photographs 618-638. The extension cord and the on-board shore cord were not connected during the fire.

No evidence of an arcing event on the 120 VAC circuit to the coach was found. The fact that all the circuits followed the same path along the north and west walls indicated a failure or interruption of the power near the source, which affected all the circuits, was the most likely reason there was no evidence of arcing on any of the circuits. The only location this could have occurred was in the electrical distribution equipment in the corner created by the apartment and the north wall. Evidence of electrical arcing was found in the electrical panel box inside the service entrance mounted on the exterior of the building. A fire originating in this area would have attacked the distribution panel resulting in arcing tripping the breakers or the breakers tripping due exposure to heat. The location of the arcing in the service entrance would have tripped out the power to the building at the fuse coming from the utility. Both events would have de-energized the circuits along the north and west walls early in the event. Once de-energized arcing could not occur on these circuits inside the building. If the fire originated in the coach the fire would have attacked the circuits not supplying power to the coach causing evidence of electrical activity on those

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circuits. The circuits were all routed near the top of the walls or over the rollup doors, which would have seen the higher temperatures earlier during the fire as the heat and other products of combustion gathered at the roof and then started banking down toward the floor creating an oven type environment. The metal roof would also serve as a reflector of the heat allowing for fire spread to areas below via radiant heat transfer. The photographs of the apartment's ceiling illustrated the effects of the heat buildup above the apartment and attacking the ceiling joist from above.

The hypothesis proposed by Plaintiffs' experts that the fire originated in the RV or at the Dometic refrigerator is not possible. The tracing of the 120 VAC power source found the coach was not connected to the 120 VAC system of the building. The shore cord's compartment was located on the driver's side of the coach. Mr. Hoog reported he kept a 50-amp extension cord plugged into the RV outlet and was routed toward the coach. The female receivers were found near the coach, but not in the same location as the male pins of the shore cord. Mr. Hoog would leave the shore cord's male plug inside the shore cord compartment until he wanted to plug it in. Mr. Hoog's original statement that the coach was "Dead", referencing the lack of electrical power, was verified by excavation of the electrical supply to the coach.

The male pins on the coach's shore cord were found near compartment door for the cord storage area. The compartment door had come off at the hinge and landed on the debris with the shore cord nearby. There was no evidence the cords were connected.

The "Store Switch" was reported to be on by Mr. Hoog in both statements to the investigators and in his deposition. It is also confirmed in Mr. Howell's report. This switch disconnects the 12 VDC power to all devices except the LP detector *Newmar Dutch Star Owner's Manual, Battery Disconnect (5:6)*. The owner's manual indicates only the LP detector remains powered. Thus, the refrigerator's control board, which operates on 12 VDC and controls the operation of the refrigerator in all modes, was not energized. The refrigerator was not capable of operating with the "Store Switch" activated, as the refrigerator requires 12 VDC to activate the controls to start a cooling cycle. The lack of 12 VDC power would disable the refrigerator and prevent the 120 VAC power from flowing to the electric heating elements, opening the gas valve and, operating the igniter for the propane burner making the refrigerator incapable of being an ignition source or increasing the pressure inside the cooling unit.

The ignition sequence listed by Plantiffs'experts fails to survive scrutiny as there are no sources of ignition powered in the refrigerator compartment or in the coach. AEGI's report indicates a leak occurred in the cooling unit prior to the fire. There is no evidence to support this hypothesis. There is contradictory evidence in the form of the overpressure rupture in the condenser area. This blowout required the cooling unit to still be pressurized.

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Edmund FD photo 44 North end Doors

Edmund FD photo 1 South end doors

Joint examinations of the two passenger vehicles were conducted on November 1st and November 30th, 2021. The examination found nothing of evidentiary value in the processing of both vehicles.

FACTS

- The fire occurred on March 30, 2018, about 2200 hrs. (10:00 p.m.)
- The building was finished in November of 2017.
- Investigator Mike Fitzgerald of the Edmond Fire Department was dispatched to the fire and conducted a preliminary investigation.
- Investigator Fitzgerald's notes indicate he had great interest in the electrical service entrance until speaking with investigators retained by Oklahoma Farm Bureau Insurance and Liberty Mutual Insurance
- Inv. Fitzgerald removed nothing from the loss location but did move the electrical distribution panel as evidenced by his photographs.
- Mr. and Mrs. Hoog had departed the residence earlier in the evening and went to dinner.
- The Hoog's were notified of the fire by neighbors via telephone and then by two calls from their alarm company.
- The Hoog's returned home after being notified of the fire.
- On the date of loss, Mr. Hoog went to the shop on the golf cart and left in the 2011 Cadillac EXT with his stepson.
- The electrical system supplying the coach was traced, excavated, and documented to not be connected to or supplying power to the coach at the time of the fire.
- Edmond Fire Department photograph 1 showing both roll-up doors on the south side of the building to be intact.
- The RV was located 13' from the southwest roll-up door.
- Edmond Fire Department photograph 10 shows the roll-up doors on the north side of the

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building with the west roll-up door intact and closed and the east roll-up door severely damaged and firefighting efforts applying water through the opening.

- The northwest roll-up door was less than 14' from the front of the coach.
- The other three roll-up doors were cut later in the fire suppression efforts.
- Edmond Fire Department photo 15 shows items on the ground next to the electrical service entrance burning.
- Edmond Fire Department photos 44 and 46 shows the north side of the building with the difference in damage to the roll-up doors and the remains of the fire damage items near the electrical service entrance.
- Mr. Keifer and Mr. Layson were not present for any of the fire scene examinations.

OPINIONS

- The fire originated outside the large, detached RV garage building.
- The building had electrical power supplied to the building at the time of the fire.
- Evidence of electrical activity was observed and documented in the electrical service entrance located in the area where the apartment's west wall and the north wall intersected adjacent to the east side of the east rollup door on the north wall.
- The roll up doors were metal on the exterior and contained what appeared to be Styrofoam insulating panels on interior side of the doors.
- The damage to the northwest and southwest roll-up doors is not consistent with the fire originating in the coach.
- The fire did not originate in the apartment located in the northeast corner of the building.
- There was no evidence of electrical activity found on the circuits routed along the north and west walls.
- There was no evidence of electrical activity on the wiring routed from the north-west corner of the apartment to the south end of the west wall.
- The examination of the two passenger vehicles could not exclude the fire originated in either Cadillac EXT or Escalade due to the extent of the damage to the vehicles. Mr. Howell concurs with his opinion in his report.
- The examination of the RV power supply found the coach was not connected to the electrical distribution system of the storage building or any other electrical source.
- The male end of the shore cord did not exit the storage compartment for the cord until after the compartment door was damaged by the fire and it fell from the coach.
- The "Store Switch" was reported to be activated by Mr. Hoog when he left the coach.
- Mr. Hoog reported the "Store Switch" was turned on when he was not using the coach.
- Mr. Hoog's original statement stated the "Coach was dead" and the examination of the electrical supplies verified this statement to be accurate.

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- The lack of damage to the southwest and northwest roll-up doors is not consistent with the fire originating in the RV.
- The damage to the northeast roll-up door is consistent with the fire originating at the electrical service entrance just east of the door.

DEVELOPMENT OF OPINIONS AS TO CAUSATION AND IGNITION SEQUENCE

This investigator examined the building, documented the various fuel packages taking into consideration the BTU output if totally consumed, partially consumed, or with minimal damage. The RV was determined to be the largest fuel load in the building. This was very evident by the damage to the steel structure and metal sheeting on the walls and roof close to the coach. The fuel load study estimated 85-90 percent of most of the fuels on the coach being either consumed or partially consumed. The fuel load for the RV also included fuels on board the coach including propane storage and diesel storage tanks, which both contained high heat release rate[1] (HRR) fuels. The portable propane bottle in the coach and the three other portable tanks on the rack storage were all considered as part of the RV fuel package due to the proximity to the coach and the wall. The ATV on the west wall was a small percentage of the heat generated by the other items in this area.

There was no surveillance equipment in the building, thus the ignition sequence of the various fuel packages must be determined by fire damage patterns where available, electrical arc mapping and fire dynamics. The heat flux[2] from the hot gas layer trapped in the top of the building continued to expand until either the building was vented by the fire department to allow the hot gases to be evacuated or the fuel load diminished as the fuel packages were consumed. Regardless of the origin of the fire the heat flux at ceiling level was the biggest factor in the involvement of other fuel packages throughout the building. The metal construction and the insulated walls, few windows, and the roll up doors being closed at the start of the fire allowed the thermal layer to expand and deepen from the roof line.

The examination of the coach, the electrical supply to the coach and the use of the "Store Switch" all indicate the coach, and its components were not a viable hypothesis for either origin or causation for this fire. The void of 120 VAC power and 12 VDC power to the coach eliminates all ignition sources in the refrigerator compartment and most ignition sources in the coach with the exception listed. The lack of power to the refrigerator eliminated the possible ignition sources common to the refrigerator during operation.

The refrigerator was examined on site and had been subjected to extreme heat and mechanical

[1] NFPA 921 Guide for Fire and Explosion Investigations 2017 edition. Pg 921-16 3.3.105
[2] NFPA 921 Guide for Fire and Explosion Investigations 2017 edition. Pg 921-16 3.3.103

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damage. The application of an external heat source on the cooling unit in this environment would both increase the pressure in the cooling unit and take the steel tubing to temperatures that start to affect the strength of the steel. The cooling unit had an overpressure rupture in the condenser, the highest point on the cooling unit, which released the ignitable gases from the cooling unit. The cooling unit had separated from the coach with the absorber vessel landing just below the floor level of the coach. The heat naturally rises and is replaced by cooler air at floor level. The rupture of the cooling unit in the condenser is due to the excessive temperatures and increased pressure. The rupture released the coolant mixture into a super-heated environment that would have ignited the gases immediately only adding to the pre-existing fire.

The Dometic Model NDR 1292 refrigerator was subjected to pressure testing, metallurgical examination, and CT scanning. The cooling unit was found to have a very small penetration *~96.89 to 103.81 mm from the bottom according to AEGI*, which during testing only lost 5 psi of pressure in an hour. The test started at 121 psi at zero time and concluded at 60 minutes with the pressure remaining being 116 psi.

The small size of the leak would not have provided enough ignitable gas to cause ignition of the gas(es) or to cause ignition and, sustain combustion long enough to involve other fuels in the area. The natural ventilation through the refrigerator compartment would dissipate a release of the lighter than air fuel gases that are part of the coolant mixture in the refrigerator due to diffusion into the atmosphere.

The metallurgical examination and findings will be addressed in detail by Dr. Richard Baron, P.E. Ph.D. of ESI who was retained by Dometic.

Mr. Tony Perryman, P.E. electrical engineer with Integrity Forensics & Engineering who was retained by Dometic will address the electrical evidence, the installation of the electrical service to and in the building, and the effects the fire had or did not have on the electrical circuits and equipment.

The limited release rate from the breach indicator during the pressure drop test 121 psi. was all through a single breach location.

A second lab examination at AEGI on August 1, 2022, was conducted after the boiler tube segment was subjected to two CT scans.

The presence of the fish mouth pressurized blow out indicates the cooling unit was under pressure when attacked by the fire. The mechanically installed dimple in the boiler area was also found deformed during the examination of the cooling unit. The deformation of the dimple is another example of the pressure in the cooling unit being in excess of normal ranges.

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AEGI discounts or ignores the clear evidence of overpressure in the cooling unit and the causes of the over pressurization, which the primary cause is being attacked by a pre-existing fire. The sequencing also fails to address the ignition sequence requiring the release of flammable gases into a location where the gas can accumulate and reach the flammable range and find a competent ignition source. The status of the coach's electrical supply excludes all ignition sources in the refrigerator compartment.

The scientific method requires testing of all hypotheses with an effort to disprove them. If the expert is attempting to prove the hypothesis correct that is having a confirmation bias[3]. The testing of a hypothesis requires deductive reasoning[4]. The facts of this case are clear, everything that could burn in the building burned to some extent. The question is the sequence of the events. Under the hypothesis stated in the AEGI and AIC reports, their testing of the hypothesis does not sequence the events needed to create the overpressure condition in the condenser or to weaken the steel. Both require added heat. In this case the evidence clearly shows the coach was not supplied with electrical 120 VAC power and the "Store Switch" was activated per Mr. Hoog's statement at the examination and in his deposition testimony *(Kevin Hoog Deposition 5-24-2022 Page 164-165 lines 24 -3, 2022)*. The purpose of this switch is to prevent the battery from being drained while stored. It turns off the 12 VDC power to the refrigerator which disables the refrigerator's operations and all other 12 VDC equipment except the LP detector.

COACH EXAMINATION METHODOLOGY

Examination of the recreational vehicle was conducted working from the exterior of the vehicle to the interior. The vehicle was divided into four areas for the examination of the exterior of the vehicle: doors and frame of the cargo areas located below the floor of the living space, passenger areas doors, windows, and roof and the front including the front cap and windshield of the coach and the under carriage as accessible. The vehicle was divided into three interior sections for the interior examination: the engine compartment, the passenger compartments and the cargo area and was examined again working from the area of least damage to the area of the greatest damage. The loss was arc mapped as allowed. Based on the examination a hypothesis of the area of fire origin was formulated. This hypothesis was then tested with a comparison to the burn patterns to determine if any inconsistencies existed. If inconsistences exist, they are examined and exploited to determine the cause of the inconsistences. The area of fire origin was then examined to determine the fuels and sources of ignition common to the area. The first material(s) ignited was then determined. The source of ignition was then determined by an examination of all the competent ignition sources for the fuels present in the area of fire origin. All determinations were then compared against the burn patterns, ventilation patterns, witness reports and electrical

[3] NFPA 921 – Guide for Fire and Explosion Investigations 2017 edition. *Pg 921-20* 4.3.10 Confirmation Bias
[4] NFPA 921- 2017 *4.3.6 Test the Hypothesis (Deductive Reasoning)*

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evidence to disprove this hypothesis. If more than one unrelated hypothesis of the fire's ignition sequence survives scrutiny then the fire is undetermined or if related hypotheses are still present, they are evaluated to determine if one is more probable than the other. If only one hypothesis survives the ignition sequence is addressed. The hypothesis/hypotheses of the ignition sequence is/are postulated and tested in attempts to exclude them. If a hypothesis survives scrutiny a cause is determined. If more than one ignition sequence survives, the surviving hypotheses are evaluated as to which is more probable. If no hypothesis of the ignition sequence survives scrutiny, then the cause is undetermined.

QUALIFICATIONS

Walter L. Oliveaux is the President and Chief Investigator of SOS Investigations, Inc., an investigative firm focused on providing expert consulting services in the fields of fire and explosion origin and cause investigations and accident reconstruction for over 30 years. My experience with SOS Investigations includes investigating over 1,000 recreational vehicle fires where gas absorption refrigeration was present and other fire losses across a broad spectrum of vehicles, vessels, buildings, industrial facilities, and construction / forestry equipment. I was a member of the fire service holding ranks from firefighter to Fire Chief for over 30 years, including being the lead investigator for the department's fire investigations division and leading numerous investigations involving arson and fire death investigations. I have thousands of hours of training in fire investigation related topics and fields.

My qualifications are summarized in greater detail in my curriculum vitae, which is attached to this report as Attachment 1. The work performed in this engagement was completed by me. My analyses and opinions reflect the consideration of the documents listed in the Attachment Index and the footnotes or citations within this report. The data, documents, and information that I considered and relied upon are the types of data, documents, and information that experts in my field typically consider and rely upon in performing such analysis. They include *NFPA 921-2017 Guide for Fire and Explosion Investigations* and *NFPA 1033-2014 Standard for Professional Qualifications for Fire Investigators* and other documents including the owner's manuals and technical documents for the travel trailer, the refrigerator, and other components of the RV. Review of RVIA documents related to this fire loss and ASTM standards regarding the requirements for technical investigators and collection of evidence and other documents listed in the attachment summary.

MATERIALS REVIEWED AND RELIED UPON

This investigator reviewed the following sources of information:

- NFPA 921-2017 Edition.

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- The deposition testimony of Investigator David Mark Howell.
- Edmond Fire Department Report
- Depositions of Mr. and Mrs. Hoog.
- Interview of Mr. Hoog and notes from the interview.
- Notes taken by Fire Department Investigator Fitzgerald
- Photographs taken during the fire suppression and investigation of the fire by the Edmund Department.
- The owner's manual for the 2007 Newmar Dutch Star
- Photographs and other materials obtained through discovery.
- The reports and photographs of Investigator David Mark Howell of AIC.
- The photographs and data from the lab examinations at AEGI.
- Information from Mr. Tony Perryman, P.E. Electrical Engineer of Integrity Forensics & Engineering report.
- Information from Dr. Richard Baron, P.E., Ph.D. of ESI. report
- Diagrams prepared at the fire scene.
- The 1016 photographs taken by me at the fire scene examination and the vehicle examinations.
- Photographs of the Hoog building prior to fire.

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SCIENTIFIC METHOD

The investigation of fire and explosion incidents are based on the steps outlined in the scientific method as described in chapter 4 of *NFPA 921 – 2017 Guide for Fire and Explosion Investigations,* which describes the seven steps of the scientific method. These steps include and are applied to fire and explosion investigations, in the following manner.

Recognize the Need	A fire/explosion has occurred
Define the Problem	The origin & cause is unknown
Collect the Data	Collect Data through interviews of witnesses and systematic examination of the scene and evidence
Analyze the Data	Evaluate the information obtained during the collection process, including laboratory analysis of items collected
Develop Hypotheses	Based on examination and laboratory analysis develop a hypothesis as to the origin of the fire/explosion
Test the Hypotheses	Evaluate the hypotheses of the origin of the fire in an effort to disprove the hypotheses (if the hypotheses can be disproven or if evidence contrary to the hypotheses is present re-evaluate the data)
Select the Final Hypotheses	Determine the origin of the Fire / Explosion (Repeat process to determine the Cause of the event)

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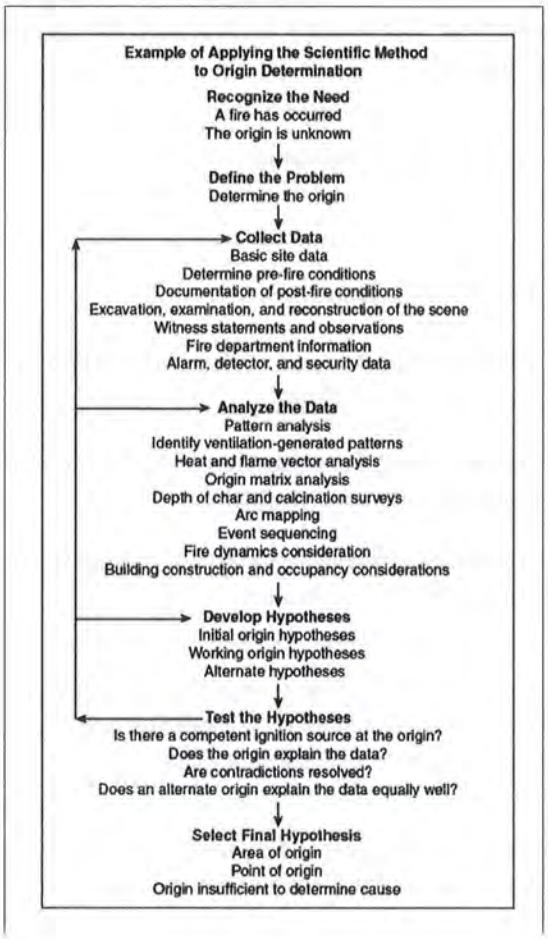
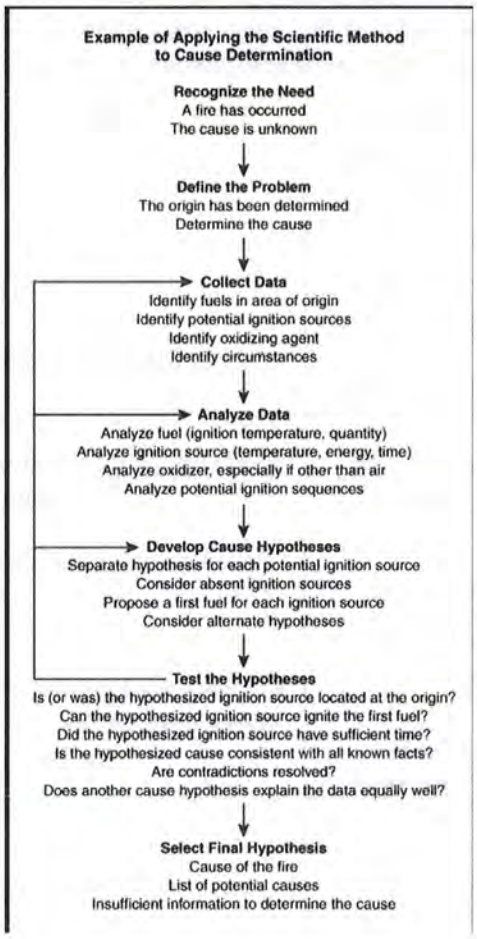
NFPA 921- 2017 provided the following two charts to illustrate the scientific method as relates to origin and cause determination.





METHODOLOGIES

The methodology used on the investigation of this fire loss included two similar methodologies, one for the building and one for the vehicles inside the building.

Examination and data collection of recreational vehicles (RV) fires are conducted working from the exterior of the RV or if stored in a shelter, the exterior of the storage area for the RV. The

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examination then moves to the interior of the storage area, and the exterior of the RV. The examination of the storage location and the exterior of the RV includes the fire damage patterns, utility services, including the power cords and ventilation patterns or flow paths out of the building and or the RV, along with damage to exposures. The examination then continues to the interior of the storage facility and ultimately to the interior of the RV(s). The examination of the interior areas is examined from the areas of lesser damage to the areas of greatest damage is a standard process in the methodology of determining origin but, the evaluation of areas of greater damage should include a determination of the fuels located in the area(s) as the greater damage does not always indicate the area of fire origin. The examination of the fire loss should identify the flow paths of the fire, the fuel packages involved and environmental influences on the fire, such as wind direction, housekeeping and other items and material either stored in or around the RV(s), among other factors.

Recreational vehicles are divided into two classifications, self-propelled and tow behinds and multiple sub-classifications based on the chassis on which it is mounted or the type of hitch for tow behinds. Both are divided into the following areas for the examination of the exterior of the vehicle: front, passenger (curb) side, driver's (road) side, rear of RV, the roof and under carriage. The interior sections of vehicles vary depending on the classification. Both classifications have passenger areas, basement storage and equipment areas. The passenger spaces are normally divided into common areas, galley, bathroom and, sleeping areas. All passenger areas include storage areas of various sizes and configurations. The passenger areas are located above floor level. Some passenger areas double as a multi-purpose space where various items can be carried or stored, which are often referred to as the garage. The garage often doubles as additional sleeping quarters and is normally located at the rear of the vehicle with a roll down access door. ATV, motorcycles, and golf carts are often transported in the garage areas. The basement storage areas are located below the floor level and are used to store items that can include, but are not limited to, outside table and chairs, barbeque grills, vehicle accessories and miscellaneous items needed while traveling and camping. Equipment areas include house and chassis battery banks and other electrical equipment including generators, inverters, and converters, leveling equipment, propane storage, and liquid fuel storage equipment on self-propelled vehicles and some towables. Water, sewer, and fuel tanks are also located in the basement area.

The determination of the area of fire origin is based on the following four methods: eyewitness accounts / video evidence, fire pattern analysis, arc mapping and fire dynamics. Each of these methods alone may be used but are better when confirmed by one or more of the others.

- Eyewitness Accounts are one of the most subjective of the four methods for determining area of fire origin, as they are only as reliable as the perspective and credibility of the witness. Stress, impairment, medical conditions, and experience levels are known to affect the accuracy of the accounts provided by witnesses. A person in a stressful situation may

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be hyper focused on a particular area or event during the fire while ignoring other obvious important details. The limited details retained leave the witness's mind to fill in the blanks, which often are filled based on incorrect assumptions and other's partial observations or opinions. All eyewitness statements should be weighed based on the support provided by physical evidence or video evidence. *(NFPA 921-2017 18.1.2 (1) Witness Information and/or Electronic Data)*

- Video evidence reliability can also be subjective in certain circumstances. The position and quality of the video equipment may leave as many questions as answers. Ambient light, angle of the camera, distance from the subject and obstructions between the camera and the subject can all affect the helpfulness of the video and cause variations in the interruption of the video. The completeness of the video can also affect the usefulness of the video.

- Fire Damage Pattern Analysis involves recognition of patterns on various materials caused by the progression of the fire and involved fuel packages. These patterns indicate fire movement and intensity and can be affected by the fuels involved in the fire, ventilation paths and certain environmental factors. These patterns, when properly interpreted and analyzed, will clearly identify the area of fire origin, and should survive testing. Pattern analysis can provide confirmation or contradiction to eyewitness testimony. Fire pattern analysis is based on extensive testing and fire dynamics. *(NFPA 921-2017 8.1.2 (2) Fire Patterns)*

- Electrical Arc Mapping is the analysis of the energized circuits in the fire-affected loss. Arc mapping is based on the electrical principle that the arc farthest from the source of power on a circuit must be the first arc that occurred on that circuit. When examining all circuits, the locations of electrical arcs located on the various circuits will create a map that indicates the only areas where the fire could originate and the area where the fire could not originate. Fire attacking an energized electrical circuit will cause arcing to occur on an energized electrical circuit. When attacked and arcing occurs, the protection device for the circuit should function and de-energize the circuit. In cases where the protection device does not function, multiple arcs can follow on areas closer to the source of the power. *(NFPA 921-2017 8.1.2 (3) Arc Mapping)*

- The analysis of the Fire Dynamics [i.e., the physics and chemistry of fire initiation and growth (NFPA 921-2017 Chapter 5) and the interaction between the fire and the building's systems (NFPA 921-2017 Chapter 7)] Involves the detailed study of how chemistry, fire science, and the engineering disciplines of fluid mechanics and heat transfer interact to influence fire behavior. In more simple terms, fire dynamics is the math behind how things burn, how fires grows and spreads to involve other fuel packages. Computer fire modeling

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is based on fire dynamics. *(NFPA 921-2017 8.1.2 (4) Fire Dynamics. (NFPA 921-2017 – 3.370)*

STATEMENTS

Information established by reporting agencies or interviews

The investigators spoke with Mr. Hoog on the first day of the examination. Mr. Hoog provided the following information:

- All lights were off in the building.
- Mr. Hoog stated, "Everything was off."
- Refrigerator was off all winter, "No Sense cooling it empty"
- Propane was on.
- The coach had a gas burner cooktop.
- The Aqua Hot was off. This device provides heat to the interior of the coach, heats the water to the engine and hot potable water.
- Mr. Hoog stated the "Coach was dead" and agreed it would have been dark and ambient temperature.
- They had not made any trips that year.
- Last trip in the coach was November 2017 when they went to a NASCAR event.
- The coach was driven the week prior to the fire to Cummins for service.
- Oklahoma RV Repair winterized the coach.
- Oklahoma RV Repair is located at I-35 and 122nd in Oklahoma City. All repairs had been completed at OK RV repair.

EXTERIOR EXAMINATION

The multi-building property was located on the west side of S. Westminster Rd. The driveway for the property entered the south side of the property. The only building on the property damaged by the fire was the RV garage.

The examination of the property found a home near the road with a pool and pool house located behind the home, overlooking a pond that separated the RV garage from the other structures. The concrete driveway was routed along the south side of the property and terminated at the north end of the RV garage.

The examination of the property found the electrical service was routed through the north side of the property and then fed some of the various structures on the property. The RV garage's power entered the building on the north side of the building just east of the roll up doors just above the

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concrete slab. The buried cable was run through PVC conduit into the bottom of the service entrance. It was housed in a metal box with an exterior cover. The cover had an arc gouge in the outside cover. Evidence of electrical arcing was found inside the electrical service entrance. The location of the arcing event would have interrupted the power to the building before the fire ever entered the building.

The examination of the RV garage started at the south side of the building, which is where the driveway approaches the building. The building was a slab on grade building with two roll up doors on the north and south sides of the building corresponding in location to the doors on the opposing end. There was a covered porch on the east side that ran the length of the building and had covered an entry door and some windows. The west side of the building had three rectangular windows near the top of the wall. The windows were located near the top of the side wall as shown in the photo below which is photos 31 and 33 stitched together.

2018-129-C Photos 31-33 Stitched.jpeg

These windows provided ventilation once the fire compromised the dual pane windows. The windows were located just below the top of the panels that line the interior of the building. The level of the window allowed it to be the primary ventilation of the building after the fire breached the windows. Part of the south wall of the apartment is shown in the right side of the photo.

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2018-129-C Photos 29-30 Stitched.jpeg

The photo above shows the northeast corner where the apartment is located on the north wall of the building, the east wall that includes the entry door and the location and proximity of the Cadillac EXT to the apartment, north door and the area of the electrical service entrance, and the Cadillac Excalade's position in relation to the EXT. The section of the south facing wall also contained a large amount of wall mounted wooden cabinets, but they did not face any of the larger fuel packages. Again these cabinets were installed over painted gypsum board.

The electrical service entrance is located just above the level of the concrete and has a square cover. The red arrow shows (photo 8 and 103) the location of the electrical service entrance. The power to the building is routed underground in conduit under the concrete areas and enters the bottom of the box via a piece of PVC conduit.

The examination of the electrical service entrance found fire damage to the PVC conduit through which the feed entered the panel. The bricks around the panel had some discoloration, but the area had obviously had some clean up done prior to the examination. The north roll-up door had severe fire damage.

A review of the photographs taken by Edmond Fire Department Investigator Mike Fitzgerald showed dimensional lumber stored near the electrical service entrance. This wood was burned and

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had to be extinguished. Other photographs show firefighters working to extinguish the areas east of the east roll up door on the north side of the building. Evidence of spalling[5] of the concrete was observed in this area confirming something burned in the area.

Photo 8 showing the northeast corner of the building

Photo 103 showing the arc gouge on the cover. and the staining of the bricks

The east side of the building contained several windows and the entry door. The glass in the windows appeared to be broken during fire suppression to supply both ventilation and access. The east side of the building is shown in photographs 609-617

INTERIOR EXAMINATION

The interior of the building contained the RV, which was parked approximately nine (9) feet from the west wall. Two Cadillac vehicles parked facing each other were fourteen (14) feet apart and approximately 13' east of the RV. The Escalade was located sixteen (16) feet north of the south wall. The Cadillac EXT was parked fourteen (14) feet south of the north wall. The roof of the building was insulated, which held the heat generated inside the building until compromised. Once the insulation was damaged and either melted or fell from the roof it became a reflector of the heat back toward the floor and began to involve additional fuel packages. The RV was both the largest and tallest of the fuel packages.

The two passenger vehicles were the two next largest fuel packages. Their proximity to each other may have added to the damage in the building but likely did not cause the ignition of the other.

Three propane cylinders were stored on rack storage adjacent to the RV and south of the north

[5] NFPA 921 – Guide for Fire and Explosion Investigations 2017 edition. 3.3.174 Spalling

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wall. The propane bottles were the next largest fuel loads in the building when they vented adding both BTU production and heat flux on to remote and adjacent surfaces. In this case the metal covered wall would reflect the heat flux back toward the RV which was less than nine (9) feet way.

An all-terrain vehicle (ATV) was parked along the north end of the west wall of the building and added some BTUs to the fire as the machine had rubber tires, plastic trim, and gasoline fuel storage.

The examination of the building found it had LED lights mounted on the ceiling in several rows and a gas fired heating system suspended from the roof. Several sections of the heating system had fallen from the roof.

The building contained an apartment in the northeast corner of the building that was approximately 25'x 23' with an entrance to the apartment on the east side of the southern facing wall. The apartment was irregular in shape. The southwest corner of the apartment had an area that was short of the most southern exterior wall. The examination of the apartment found some irregular framing practices as related to the ceiling of the apartment. The ceiling joists were approximately 24 inches on center instead of the normal 16 inches. As the fire grew inside the building the heat that had accumulated in the peak of the roof continued to increase and was reflected toward the items at floor level and the ceiling structure of the apartment. The apartment had suffered fire damage from top down as the thermal layer descended toward the floor. The full BTU output of the apartment was never realized as the fire suppression efforts appeared to be deployed to the east side of the building with fire suppression efforts advancing into the building. The rollup doors on both ends of the building did not appear to be cut. The northeast door had failed due to fire exposure before any of the other doors were cut and possibly prior to the arrival of firefighters. The cutting of the other three roll up doors was to allow application of water into the building for fire suppression. The holes in the doors were not cut to provide ventilation to allow the heat to escape the building. Some holes were ultimately cut into the west wall. The failure of the windows along the west wall stopped or slowed the thermal layers descent toward the floor. The widows on the east side of the door allowed combustion air to be entrained into the fire due to their proximity to the floor.

The exterior of the apartment was of normal framing and covered with OSB sheets and then finished with sheet rock, a fire resistive product. The sheet rock was installed over the OSB with screws. The cabinets were installed on both the west facing wall and the north facing wall as illustrated in the photographs taken prior to the fire by the plaintiffs. These cabinets provided fuel on the west side and protection from the fire on the south facing side.

The west facing side of the apartment contained a closet with the water heater and a storage tank. The compartment was located approximately three to four feet from the electrical distribution panel in the corner created by the north wall of the building and the west wall of the apartment. The closet had what appeared to be an MDF (medium-density fiberboard) door, which provided

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some protection for the closet until the hardware hanging the door failed due to thermal injury. The fire department photos included with the report shows the electrical distribution panel collapsed to the floor before the water heater closet door fell. The south facing wall had suffered greater damage in the corner created by the different depths of the north/south dimensions of the two sections of south facing wall. The area of greatest fire damage to the wall matched the location of the stove in the kitchen area of the apartment. Propane was routed through this wall to supply the stove, which could explain the greater damage if the flexible hose connecting the hard pipe to the appliance was damaged.

The examination of the north wall of the apartment and the north wall of the metal building found fire damage between the two. The fire had spread from the corner created by the intersection of the apartment wall and the north wall of the building. This area would have been shielded due to the construction from the heat generated by both the Cadillac EXT and the RV. The only ignition source in this area was the electrical service entrance. This space was insulated with spray in closed cell foam insulation. Exterior photos of the area showing some of the fire damage in the wall via openings created during suppression efforts (SOS photos 98-102).

The examination of the apartment excluded the fire originating inside the apartment.

Southeast Floor Area

The southeast section of the building had little to no contents in the area. Thus, the fuel load was small. The thermal layer generated by the fuel packages in the other areas of the building spread into the roof area of the building from the other parts of the building as the roof/ceiling temperature equalized across the entirety of the buildings as the thermodynamics of the building's construction and fuel packages becoming involved in the fire created turbulence in the upper part of the building. There is a saying in the fire service that fire creates it's own weather. The lack of contents in the southeast part of the building is shown in photos 38-41 that were stitched together below. The lack of contents allowed some of the insulation to remain after the fire was extinguished. There was no evidence indicating the fire originated in this area of the building.

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Photos 38-41 stitched together

Electrical Service Entrance

The electrical service entrance was located on the north end of the building just east of the eastern most roll up door. The electrical service was routed underground to the building where it came up inside a metal box in the wall just above ground level. The electrical service came from the roadway via the north side of the property. The metal box that landed the electrical service was inset in the wall and backed up to the electrical distribution panel. The service wires left the metal box and entered the lower rear of the distribution panel. There was no evidence of a metal nipple between the two boxes. There was evidence of the locking rings that would be used on PVC pipe. The wall was insulated with fiberglass insulation with a plastic type backer. Remains of the insulation were found behind the electrical distribution panel with fire damage near the opening through which the electrical wiring supplying the panel entered the distribution panel.

Electrical activity was found in the electrical service entrance. An arc gouge was observed on the cover for the metal enclosure. Evidence of damage to the wiring was obvious. The cause of the damage was due to an attacking fire from the burning wood located near the service entrance on the exterior of the building. The location of the arcing explained why there was no evidence of electrical power being present in the building because this arcing in the service entrance would have opened the pole top fuse or other circuit protection device that separates the utility distribution system.

Building Electrical Service

The buildings electrical service was routed on top of the purlins and through holes cut into most of the purlins with some chafing protection. The wiring leaving the electrical panel was routed

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through holes in purlins at several levels and then turned west and went across the top of the roll up doors. The power for the electric garage doors openers were routed across the purlin that was the top of the door opening and had switch circuits for the electric openers routed along the side of the doors. Mr. and Mrs. Hoog had remotes for the doors in their vehicles.

Other circuits continued across the north wall and on to the west wall. The west wall had multiple levels of purlins carrying circuits. In some areas the circuits turned down to supply each one of the duplex outlets located in the west wall and the RV outlet.

Based on the location of the electrical distribution equipment, the routing of the circuits and the position of the coach, the circuits along the north and west side of the building were examined, labeled, and collected for laboratory analysis for evidence of arcing. The examination of the circuits during collection found no evidence of arcing or evidence the circuit were energized when subjected to the fire and heat.

The circuits were collected from the southwest corner of the building to the northwest corner and then from the northwest corner across the north side of the building to the electrical distribution panel.

RECREATIONAL VEHICLE

Examination of the RV was conducted working from the exterior of the coach. The examination included tracing the electrical supply to the coach. The tracing of the extension cord was continued toward the coach and found it was not connected to the shore cord of the coach. The male pins of the shore cord were found near the aluminum door for the shore cord compartment that had separated from the coach. The male pins of the shore cord were found to not be connected or within a reasonable distance from the female receivers of the RV extension cord. This confirmed the RV was not supplied with 120 VAC power. The lack of power to the coach would exclude the 120 VAC system from being a source of ignition for the fire.

Mr. Hoog reported multiple times that the "Store Switch" of the RV had been activated. This switch disables the 12 VDC electrical system to all components on the coach except the LP detectors. The interruption of the 12 VDC power disables the coach's refrigerator as all the controls for the refrigerator are disabled and the refrigerator will not operate. This also excludes the refrigerator from being an ignition source for the fire as the 120 VAC elements could not be activated.

ENGINE COMPARTMENT

Examination of the engine compartment found severe fire damage to the compartment and

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consumption of most of the combustibles in the compartment. The vehicle had not been run in about a week which excludes hot surface ignition. The vehicle not running also excludes DC power being provided by the alternator. There were some remains of the rear cap of the coach. If the fire originated in the engine compartment the fire would have spread up through the rear cap and would have consumed the fiberglass components of the rear cap.

The fire did not originate in the engine compartment of the RV.

PASSENGER COMPARTMENT

The passenger compartment was constructed of a combination of wood and metal structure for the RV's floor and basement compartments. The other parts of the passenger compartment were constructed of wood framing members attached to the frame. Pieces of roll metal material are also run through the walls to strengthen the upper structure of the coach. Most of the combustible materials in the structure above the floor level were consumed by the fire.

Two roof top air conditioners were mounted on the roof of the coach. One air conditioner unit was found in the front of the coach in the debris and at floor level just aft of the cockpit. The second was found near the rear bedroom area.

Both roof top AC units still had a significant amount of the copper coils of the AC unit. The melting temperature of the copper is 1982°F. As the coach was consumed and fire suppression was started the temperature would have dropped.

BASEMENT COMPARTMENTS

Examination of the basement compartments found the propane tank on the driver's side of the coach and approximately eight (8) to ten (10) feet behind the cockpit area. The propane tank on the coach had vented and discharged an undetermined amount of propane into the area of the west wall. The portable tank that was in the storage compartment had been attacked by the fire and suffered damage.

Moving aft from the propane tank we located the compartment that housed the shore cord. This compartment had a notch taken out of the frame that allowed the power cord to exit the compartment with the door closed. The door was found on top of some debris on the floor. There was no evidence of the cord being routed through the notch. The examination found the cord was contained within the compartment prior to the fire and the compartment door being breached by the fire

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GAS ABSORPTION REFRIGERATION

The modern gas absorption refrigerator used in recreational vehicles employs a mixture of water, ammonia, sodium chromate, a corrosion inhibitor, along with hydrogen gas to remove heat from the food storage sections of the refrigerator and its contents. These units do not have a compressor like household refrigerators. The gas absorption cooling units are charged to a resting pressure of 350 psi., depending on the model. The cooling process is initiated with the application of heat derived from either energizing 120 VAC electric heating element(s) or igniting a propane burner. The application of heat on the cooling unit in the boiler section results in heat being transferred into the coolant mixture via conductive heating and the gasification of the ammonia and its separation from the water, which makes up 80 percent of the cooling mixture. The ammonia gas rises into the condenser section near the top of the cooling unit where it returns to a liquid state and moves into the evaporator section where the hydrogen gas is present. When the ammonia mixes with the hydrogen it returns to a gaseous state. The ammonia gas wanting to remain in the gaseous state absorbs heat from the tubes of the cooling unit and attached cooling plates and fins, which are inside the insulated food storage box. This process draws heat out of the insulated box and its contents. The operation of the cooling unit is initiated and controlled by a 12 VDC control board, which based on readings from a series of thermistors inside the insulated food storage boxes determines when heat is applied to the cooling unit and from what source the heat is applied. The refrigerators have only two operating modes, automatic and gas only. When in automatic, the refrigerator defaults to 120 VAC power if present to supply heat for a cooling cycle. In the absence of 120 VAC power the unit ignites the propane burner. In gas mode, the unit operates on propane. The control board is attached to a flame sensor and if the sensor does not detect a flame within a set period of time it locks out the cooling unit. This requires a reset of the refrigerator by cycling switch to off and back on. The process repeats if a failed to ignite signal is detected. The number of cooling cycles is determined by numerous factors including the ambient temperature, how often the insulated storage area is opened, contents or lack of contents stored inside the insulated box and the position of the cooling unit in relation to level and altitude.

REFRIGERATOR ENCLOSURE

Gas absorption refrigerators are installed in an enclosure in the recreational vehicle that prevents it from exchanging air with the living space of the vehicle. This requirement is to prevent the introduction of the products of combustion from the propane burner into the living space and the consumption of the oxygen from the living space by the burner. This enclosure is manufactured by the recreational vehicle manufacture to dimensions specific to the various refrigerator models. The enclosure must have a fresh air vent near the bottom of the enclosure in the exterior wall at the rear of the refrigerator and an exhaust vent near the top of the enclosure. The fresh air vent provides combustion air, and the exhaust vent evacuates the products of combustion from the enclosure. The operation of the cooling unit creates heat, which naturally rises and creates a

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chimney effect inside the enclosure, which naturally draws the products of combustion out of the compartment.

The refrigerator enclosure in recreational vehicles is manufactured with smaller dimensional wood framing members and pressboard paneling type materials on the forward and aft facing sides. The exterior wall is normally finished with a pressboard material that is secured to the wall framing, which can be either wood, steel or aluminum studs depending on the frame of the RV. The front of the compartment, the side facing into the coach and opposite of the exterior wall, is trimmed to match the interior finish of the coach and is normally dimensional materials with a greater mass than the other sides. The bottom of the compartment is a piece of plywood set 8-12 inches above floor level, allowing enough room often for a furnace and/or the electrical distribution panel. As previously mentioned, the exterior wall has a fresh air vent, which is located with the opening starting just below the top edge of the plywood floor to facilitate the release of transient propane in the event of a propane leak or failed ignition of the propane burner. Propane is a heavier than air gas and should be expelled from the compartment as it falls out of the compartment where it diffuses into the environment. The exhaust vent is located either in the roof of the coach just inboard and parallel to the exterior wall or in the exterior wall near the top of the refrigerator in vehicles where the refrigerator is in a slide room. The refrigerator compartment should be constructed with interior dimensions specific to the refrigerator model and have sealed barriers restricting air flow across the top of the insulated box to the front of the cooling unit to maintain the chimney effect and ventilation through the exhaust vent. The enclosure is constructed and inspected by the vehicle manufacturer to meet the installation requirements for the refrigerator.

In recreational vehicles where the refrigerator is not installed in a slide room, the refrigerator compartment allows a path from floor to roof and is used by vehicle manufactures as a chase for both 12 VDC and 120 VAC wiring. The bundles can be run together but are often separated with the DC and AC circuits on opposite sides of the fresh air vent along the exterior wall. A propane line, 120 VAC outlet circuit, 12 VDC circuit supplying power to the refrigerator and, if the refrigerator is equipped with an ice maker, a water supply is routed into the compartment normally through the plywood floor of the compartment at the rear of the refrigerator. The electrical outlet is normally located on the opposite side of the boiler area while the propane and water are often routed into the compartment in the middle or on the same side as the boiler section of the cooling unit. The 12 VDC circuit is normally routed through the compartment floor separate from the wiring bundles.

When properly constructed, the enclosure should not exchange air with the living space of the vehicle. Due to the pre-existing vent openings in the roof above the refrigerator compartment, the damage above the refrigerator compartment is often greater even if the fire originates outside refrigerator enclosure, which is of lighter construction than the roof of the trailer and coaches.

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OVERPRESSURE CONDITIONS & IGNITION SEQUENCE

Gas absorption cooling units are pressurized to between 325 and 350 psi resting pressure during manufacture, depending on the manufacture and model. The operating pressures may vary based on ambient temperature and altitude. All cooling units are tested to several times operating pressure before being charged with the coolant during manufacture.

Real world conditions vary and can affect the pressure at which a cooling unit ruptures. In a testing environment, the cooling unit's internal pressure is adjusted by control equipment until rupture occurs, whereas in the real world the resting pressure in the cooling unit has been fixed when the unit is charged and sealed at the factory. The pressure remains that way until an opening is created in the cooling unit or heat is applied to the cooling unit.

For a cooling unit to reach an over pressure rupture, the following conditions are required:

1. The cooling unit must have the coolant mixture present.
2. There cannot be an opening in the cooling unit that prevents pressure rise.
3. Additional heat must be imparted on the cooling unit in a manner and rate to cause the pressure to rise before the over pressure protection in the cooling unit reaches its melting temperature between 280 and 300° F. This over pressure protection is a solder plug inside the absorber vessel plug, which is built into the absorber vessel of the cooling unit.

Over pressure conditions in RV gas absorption cooling units are normally caused by a fire attacking the cooling unit, which is a pressure vessel. During normal operation, the amount of heat imparted on the cooling unit is regulated by the control board, which limits the electric heater(s), or the output of the propane burner based on inputs from thermistors in the food storage areas to the amount of heat required to reach and then maintain maximum efficiency. Heat is then transferred into the section of the cooling unit where the liquid portion of the coolant is present, which allows for heat transfer into the coolant through conduction. The water portion of the coolant helps regulate the temperature of the steel tubing in the boiler area and the amount of heat imparted is controlled based on the known amount of coolant.

When a fire attacks the cooling unit, there is no control over the amount of heat imparted on the cooling unit and the coolant solution. Additionally, the heat from an attacking fire is not imparted only in the area where the liquid coolant is present. Depending on where the attacking fire originates, the fire may attack an area where limited liquid coolant is located. The imparting of additional heat by a fire causes a temperature increase of the carbon steel tubing, resulting in greater gasification of the liquid coolant mixture or inhibits the ability of the gas to return to a liquid state resulting in an increase in pressure. The added heat also begins to degrade the steel's

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strength, when the steel reaches temperatures greater than 800° F. Between 1,000 and 1,200° F. the steel loses approximately 50 percent of its strength. This increased heat also continues to increase the pressure inside the vessel.

Similarly, water, which makes up 80 percent of the coolant, does not produce steam during normal operation (i.e., at normal operating temperatures and pressure). During normal operation, the liquid water and ammonia coolant solution is pumped up to the top of the boiler area where the ammonia boils and separates from the water and continues into the condenser section. This allows the liquid water to run back down inside the boiler section to control the temperature of the tubing wall. The ammonia gas returns to a liquid state in the condenser and then starts running down into the evaporator where it mixes with the hydrogen gas, which turns the ammonia back to a gas. The ammonia – hydrogen mixture changes back to a gas and then absorbs heat via the aluminum cooling plates and fins to remain in a gaseous state. When a fire attacks the cooling unit, these upper levels of the boiler section are heated by the fire and results in additional gasification of the coolant mixture including the water. At the elevated temperatures caused by an attacking fire, the water begins to boil and expands into steam at a rate of greater than 1,000 times the liquid volume, creating a pressure rise inside the cooling unit. The heat also creates additional expansion of the liquid ammonia and hydrogen gas, which increases the internal pressure on the system. The net effect of the external heating from the fire is the increase in temperature of the steel tubing, which weakens the steel and the increase in the internal pressure until a rupture occurs. These ruptures are often referred to as a fish mouth rupture due to their appearance. They are conclusive evidence of an abnormal operating condition causing a high temperature overpressure event within the cooling unit due to an attacking fire.

An over pressure rupture *cannot* occur if a leak in the cooling unit has previously occurred in the boiler area. Rather, a leak during normal operation in the boiler area allows for the release of the liquid portion of the coolant to the level of the opening(s) and, therefore, a drop in internal pressure in the cooling unit. This pressure drop occurs due to the increased internal volume for the gases to occupy and the release of these gases through the opening once the liquid falls below the opening(s). The loss of liquid also allows the temperature of the metal tubing in the boiler area to rise as the liquid line falls toward the bottom of the cooling unit. The absence of liquid coolant available to absorb the heat input from the electric heating element(s) or propane burner will allow the temperature of the boiler area of the cooling unit to increase. This increase in temperature results in the remaining water in the boiler section to begin to gasify. The steam created from the remaining water begins to mix with the gases expanding into the spaces formerly occupied by the liquid coolant. This moist gas mixture will also be expelled from the vessel through any openings. Pure hydrogen has an ignition temperature of 932° F. *(NFPA 921-17 table 23.8, page 921-241)*. As the water is boiled out of the cooling unit and expelled, the mixture released is a moist ammonia – hydrogen mixture. The ignition temperature of anhydrous ammonia is 1204 ° F. *(NFPA 921-17 table 23.8, Anhydrous Ammonia page 921-241)*. Ammonia attracts moisture, which means the

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ignition temperature should be greater than pure anhydrous ammonia as the moisture absorbs heat. Ignition can only occur if the breach in the cooling unit supplies enough fugitive gas to maintain an ignitable cloud in the presence of a competent ignition source. Examples of a competent ignition source is an open flame or sparked ignition. The flammable range of pure hydrogen is 4% to 75% by volume, while anhydrous ammonia has a flammable range of 16% to 25%. Both gases are lighter than air and will rise after escaping the vessel.

The leak rate of the liquid and gases from the refrigerator and the rate of temperature increase in the boiler section are essentially proportional to each other. A large hole results in rapid release of the coolant in both liquid and gaseous form until ambient pressure is reached. The rapid release allows the gases to dissipate into air before the temperature of the cooling unit components can exceed the ignition temperature of the fuels. The heat energy imparted on the steel by the heating sources does not change, but the temperature of the steel increases at a rate affected by ambient temperature, heat loss to air and conduction into other areas of the cooling unit. A smaller hole reduces the amount of fuel gases available to mix with the air and reduces the ability of those fugitive gases to reach the flammable ranges of the fuels as the mixture defuses into the atmosphere due to the natural venting of the compartment. The smaller hole also slows the temperature rise as the remaining liquid continues to absorb heat from the source. The mixture remains moist from the presence of the water, making ignition of the escaping gases require more ignition energy. The fuel to air mixture is also affected by the leak rate, which can result in either a mixture that is too lean to sustain combustion or too rich to ignite.

It is only when the fuel to air mixture is within the flammable range for the fuel that a fire can ignite. The rate at which the fuel is being supplied and the ignition source must both be competent in temperature and energy to cause ignition. To maintain combustion the leak rate must provide enough fuel and air to maintain the combustion process. The fuel source is a finite value and is not unlimited. As the fuel is expelled from the cooling unit and dissipates into the atmosphere, fuel is lost, and BTU values reduced. If ignition is achieved, the combustion process must last long enough to produce enough energy to ignite other fuel packages adjacent to the refrigerator while overcoming the loss of heat from the naturally occurring ventilation of the refrigerator enclosure and other factors, such as ambient temperature and humidity. These factors are the reason in my experience that only a very small fraction of the refrigerators that develop a leak result in a fire in relation to the population of refrigerators.

Passenger Vehicles

Two passenger vehicles were parked in the building. Both were parked parallel to the passenger side of the RV, which was facing north. The vehicles were a Cadillac EXT pickup that was parked facing south and the Cadillac Escalade was parked facing north. The Escalade was parked with nothing close to the passenger side of the vehicle. The EXT was parked adjacent to the apartment

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and approximately 10 to 12 feet south of the electrical distribution panel.

The Escalade had greater damage to the driver's side that was facing the RV, which was mostly consumed and generated the majority of the heat in the building. The radiant heat from the RV caused extensive damage to the driver's side of the Escalade. The damage to the windshield, which detached at the top of the windshield opening and allowed the glass to lay across the top of the dash. The windshield in the EXT was also laying on the top of the dash. This occurs when the top of the windshield glass is attacked and weakened and then starts to release from the windshield opening. If the fire originated in the engine compartment of the vehicle the glass would be attacked at the bottom and the glass would release at the bottom of the windshield opening and would fall into the front floorboard of the vehicle.

The damage to the passenger vehicles was extensive.

Cadillac Escalade

The examination of the Escalade found melting patterns in the driver's side of the engine compartment to be greater than the passenger side of the engine compartment consistent with the heat generated by the RV which was approximately thirteen (13) feet from the driver's side of the Escalade. The Escalade was approximately fourteen feet from the front of the Cadillac EXT. Evidence of severed and fused battery cables were found in the passenger side rear of the Escalade as illustrated in photographs 106-142. The driver's door of the Escalade was open when examined. The combustible materials in the interior of the vehicle were mostly consumed.

The examination of the Escalade indicated the heat attacked the top of the vehicle and the top of the hood and the heat generated by the burning RV also attacked the vehicle. Once involved in the fire the Escalade became another fuel load producing heat that added to the thermal layer in the upper part of the building and radiating heat back toward the floor.

Cadillac EXT

The examination of the EXT found the top of the hood had suffered similar damage to the top of the hood and roof of the Escalade. The open bed of the EXT had several plastic components that were consumed by the fire and added to the BTU output of the vehicle. The sunroof had melted and was found inside the passenger compartment. The greatest damage to the EXT on the driver's side rear quarter panel and driver's side rear door. The damage patterns supported the fire originating in the electrical service entrance and the electrical panel. The examination of the EXT was documented in photographs 316-335.

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HYPOTHESES OF ORIGIN CONSIDERED

1. **Hypothesis Considered:** *The fire originating in one of the two Cadillac vehicles.* The examination of the two vehicles at the loss location and subsequent examinations at a salvage yard could not exclude the fire originated in one of the two Cadillac vehicles due to the extent of damage to the vehicles, including to their electrical systems.

2. **Hypothesis Considered:** *The fire originating in the area between the driver's side of the coach and the west wall of the building.* The examination of the contents along the west wall of the building and the electrical circuits that were routed through the area found no evidence of electrical arcing. A fire originating in this area would have attacked the energized circuits leaving some evidence of electrical arcing. No such evidence was noted during the collection of the electrical circuits or during the lab examination of the electrical circuits.

3. **Hypothesis Considered:** *The fire originating in the RV.* If the fire originated in the RV, the fire would have attacked the electrical circuits routed along the west wall and north wall. The attached diagram of the building illustrates the locations of the RV, and other items between the coach and the west wall. The circuits were reported to be energized, including the circuit that supplied power to the RV. There was no evidence observed indicating the circuits were attacked while energized. The circuits mentioned not having evidence of electrical activity indicates the circuits were not energized at the time of the fire. If the circuit supplying the coach was not energized the refrigerator could have only operated on propane. Mr. Hoog reported the RV was in "Store Mode". This switch disconnects the 12 VDC power from all loads except the LP gas detectors. Mr. Hoog repeated that he turned the switch to "Store Mode" multiple times during interviews with investigators and later in his deposition.

4. **Hypothesis Considered:** *A failure of the refrigerator caused the fire.* During the interview with the experts, Mr. Hoog was asked what his normal process was when he stored the RV. He first reported the refrigerator was off and the door was open. He also made the comment "no sense cooling it empty". After the interview, Attorney Terrance Beard took Mr. Hoog outside and away from the investigators and then after their discussion, Mr. Hoog returned and said the refrigerator was on because they had some coffee beans in the refrigerator, and it was on to keep the beans fresh. In Mr. Hoog's deposition he responded that the refrigerator was on and being powered by the generator. Mr. Hoog then reported he left the coach after turning the coach to "Store Mode". This switch disconnects the 12 VDC power to the refrigerator, which is required for the refrigerator to operate in either Auto or Gas

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mode. With the "Store Mode" activated the refrigerator would not have been in operation. In addition, excavation of the power cord found the coach was not supplied with 120 VAC power. Mr. Hoog's Deposition testimony was different from both statements given during the site examination. *Kevin Hoog Deposition 5/24/2022 pg178 line 14 – pg. 179 line 4.*

5. **Hypothesis Considered:** *The fire originated either inside or outside the north wall east of the east roll up door.* The examination of the area found fire spread patterns indicating the fire attacked the items being stored on the exterior of the west wall of the apartment and the Cadillac EXT. The examination of the electrical circuits found evidence of electrical activity only in this area of the building, but in the electrical service entrance and not in the electrical distribution panel or on circuits inside the building. The lack of evidence of electrical activity outside this area does not support an area of fire origin being outside this area, as electrical evidence should be present. The review of Edmond Fire Department photographs documented that lumber outside the building and adjacent to the electrical service entrance had burned outside the closed roll-up door. With the door closed there was no way the material was thrown from the interior of the building during fire suppression. The photographs show this material smoldering with some areas still glowing. This is the only area where all fire spread patterns and electrical activity can support the origin of the fire.

DETERMINATION OF AREA OF FIRE ORIGIN

The examination of the building, the electrical system of the building, and the contents of the building all indicated the fire originated on the north end of the building in lumber being stored on the concrete next to the electrical service entrance, just east of the east rollup door. The fire then spread into the building via the path of the electrical conductors. The fire then involved the insulation on the electrical wiring in the electrical distribution panel before exiting the panel to involve other fuel loads associated with the contents and components of the building.

DETERMINATION OF FIRE CAUSE

The area of fire origin was partially cleaned and cleared prior to the examination by this and most other investigators. Photographs taken during fire suppression and after show fire damage to the exterior of the electrical service entrance and items burning near the electrical service entrance. The ignition source of the materials outside the building is undetermined due to spoliation of the area of fire origin. The spoliation could be intentional or accidental. Materials burning outside the building and adjacent to the electrical service entrance was the heat source that caused the fire in the building. Electrical arcing in the electrical service entrance was most probably caused by heat being imparted on the outside of the electrical service entrance resulting in heat transfer to the insulation on the wiring and an arcing event and ignition of the wiring insulation. The fire then

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spread into the electrical panel. The primary fuel allowing the fire to spread into the building from the service entrance was the insulation on the wiring in the two electrical enclosures. The fire then spread to the insulation on the wiring exiting the electrical distribution panel. The electrical service entrance was either connected to the electrical distribution panel with a PVC conduit or the wiring was routed through an opening in the service entrance and an opening in the distribution panel. There were no remains of PVC conduit, but we did find locking rings in the EDP. The geometry of the fuels available and the openings in the top of the distribution panel allowed the heat generated in the lower part of the service entrance and the distribution panel to be channeled upward across the insulation and then vented through the top of the panel, which ultimately detached from the wall and fell against the wall of the apartment's water heater closet.

The electrical distribution panel was supported by and secured by wood framing members instead of metal Unistrut. The attacking fire damaged and consumed the wood framing members resulting in the panel falling forward and against the door of the water heater closet. The fire outside and around the electrical distribution panel involved the insulation in the roll-up doors and the storage areas on the west wall of the apartment.

PHOTO SUMMARIES

PHOTO NO.	FIRE DEPARTMENT PHOTO DESCRIPTIONS
1.	FD photo 1 South side of the building.
2.	FD photo 2 southeast corner of the building.
3.	FD photo 3 looking toward the pond and pool house.
4.	FD photo 4 showing fire damage above the southwest garage door.
5.	FD photo 5 showing the fire damage to the peak of the roof.
6.	FD photo 6 showing the southwest corner and the West side of the building.
7.	FD photo 7 showing the West side of the building and the items parked along the side of the building.
8.	FD photo 8 showing the northwest of corner of the building.
9.	FD photo 9 showing the north end of the building with fire in the area of the west wall of the apartment and north wall.

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10. FD photo 10 showing fire suppression activities at the north end of the building.

11. FD photo 11 showing fire suppression activities at the South end of the building West door.

12. FD photo 12 showing fire suppression activities at the southern end of the building.

13. FD photo 13 showing fire suppression activities by firefighters Griffin and Miles.

14. FD photo 14 showing the fire inside and to the east (left) of the east rollup door on the north wall.

15. FD photo 15 showing burned items in the area outside the Northeast roll-up door that has been partially to mostly consumed by a fire external to the building and adjacent to the electrical service entrance showing the roll-up door was down and extremely damaged while all others were cut to allow fire suppression efforts. Exterior light fixture on the ground in bottom left.

16. FD photo 16 showing fire suppression efforts at the South end of the building by FF M. Miles.

17. FD photo 17 showing the northeast corner of the building.

18. FD photo 18 showing the fire suppression efforts at the northeast and east side of the building.

19. FD photo 19 showing the fire suppression efforts and fire seen through the north window on the east side of the building.

20. FD photo 20 showing fire suppression effort on the east side of the building by FF Gibson.

21. FD photo 21 showing fire suppression effort on the east side of the building by FF Gibson.

22. FD photo 22 showing fire in the northwest corner of the apartment.

23. FD photo 23 showing the heat signatures of the fire burning in the roof over the north-east part of the building.

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24. FD photo 24 blurry photo of east side of the building.

25. FD photo 25 showing fire involvement in the northwest corner of the apartment.

26. FD photo 26 showing the roof after darkening of the fire in this area.

27. FD photo 27 under exposed and dark on east side of the building.

28. FD photo 28 showing fire involvement via windows and door on the east side of the building.

29. FD photo 29 showing fire suppression efforts via the south window on the east side.

30. FD photo 30 showing the fire suppression efforts by FF ?armasson (cannot see first letter of name).

31. FD photo 31 showing the south end of the building and efforts to cut the southwest roll up door.

32. FD photo 32 showing FF J. Benne, at cut in one of the roll-up doors.

33. FD photo 33 showing fire suppression efforts at opening in a south roll up door by FF. Gary, B. Powell, J. Benne and ?armasson.

34. FD photo 34 showing closer view of fire suppression efforts on south side of the building.

35. FD photo 35 showing firefighter on truck.

36. FD photo 36 showing south end of the building.

37. FD photo 37 showing the covered door on the south end of the building.

38. FD photo 38 showing the cuts in the southwest roll-up door.

39. FD photo 39 showing the fire damage to the area above the southwest roll-up door.

40. FD photo 40 showing the south end of the west wall.

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41. FD photo 41 showing the middle of the west wall.

42. FD photo 42 showing the storage garage on the west side of the building with the door open.

43. FD photo 43 showing the north end of the building after the fire was controlled and the sun was coming up showing the materials near the electrical service entrance.

44. FD photo 44 showing a better view of the charred items near the electrical service entrance.

45. FD photo 45 showing the northwest door and the fire damage on the exterior of the Northwest corner of the building.

46. FD photo 46 showing the northeast roll-up door, the burned materials near the electrical service entrance and the thermal damage to the electrical service entrance.

47. FD photo 47 showing the ceiling damage in the north covered roll-up door.

48. FD photo 48 showing the damage to the roof inside the building from the northeast roll-up door.

49. FD photo 49 showing another view of the materials burned on the concrete and the damage to the electrical service entrance.

50. FD photo 50 showing the damage to the northeast corner of the building after sunrise.

51. FD photo 51 showing the damage to the northeast corner of the building.

52. FD photo 52 showing the northeast corner of the porch on the east side of the building.

53. FD photo 53 showing broken window on the north end of the building.

54. FD photo 54 showing the two north windows on the porch on the east side.

55. FD photo 55 showing the entry door and two windows on the east side of the building.

56. FD photo 56 showing the southeast part of the porch.

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57. FD photo 57 showing the interior of the building from the east side.

58. FD photo 58 showing the interior view of the souths side of the apartment and two passenger vehicle remains.

59. FD photo 59 showing the remains of the rear cap of the coach.

60. FD photo 60 showing the deformity of the roof over the coach.

61. FD photo 61 showing the deformity of the roof over the coach.

62. FD photo 62 showing the engine compartment and rear of the coach.

63. FD photo 63 showing the passenger rear corner of the coach.

64. FD photo 64 showing the west wall of the building.

65. FD photo 65 showing the passenger side of the coach from the passenger side rear corner.

66. No Photo 66.

67. No photo 67

68. FD photo 68 showing the driver's side rear corner of the coach.

69. FD photo 69 showing the rack storage along the west wall. There were two sections of storage racks in this photo. During the first examination of the fire scene by this investigator only one section of rack storage was still assembled.

70. FD photo 70 photo of the rear cap of the coach.

71. FD photo 71 showing the driver's side of the Escalade with both driver's side doors open.

72. FD photo 72 showing two firefighters standing outside the building southside.

73. FD photo 73 showing the south end of the west wall.

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74. FD photo 74 showing the interior of the west all near the south end of the wall.

75. FD Photo 75 showing the tracks for the roll-up door deformed by the heat.

76. FD Photo 76 showing the interior area above the east door on the south side of the building

77. FD photo 77 showing the fire damage or degree of damage in the southeast part of the building.

78. FD photo 78 showing wall over the east side of the building.

79. FD photo 79 showing the southeast part of the building and east wall.

80. FD photo 80 showing the center of the interior of the east wall.

81. FD photo 81 showing the exterior of the apartment including the south facing wall and the west facing wall.

82. FD photo 82 showing the north end of the interior of the building.

83. FD photo 83 showing the northwest corner and part of the remains of the coach.

84. FD photo 84 showing the middle of the west side of the building and the coach remains. Photo under exposed.

85. FD photo 85 showing the deformity in the roof on the west side of the building over the remains of the coach.

86. FD photo 86 of the passenger front corner of the Escalade.

87. FD photo 87 of the passenger side of the Escalade.

88. FD photo 88 showing the driver's side front rim remains.

89. FD photo 89 showing the passenger side rear of the Escalade and the rear rim.

90. FD photo 90 showing the driver's side of the Escalade.

91. FD photo 91 showing the remains of the driver's side rear rim on the Escalade.

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92. FD photo 92 showing the remains of the driver's side front tire and rim on the Escalade.

93. FD photo 93 showing the passenger side of the coach and the remains and location of the washer, dryer, and refrigerator in the coach.

94. FD photo 94 showing the passenger side of the coach forward of the refrigerator to the electric ice chest in the basement storage area.

95. FD photo 95 showing the passenger front and hood of the Cadillac EXT and the damage to the rims.

96. FD photo 96 showing a closer view of the passenger front wheel area.

97. FD photo 97 showing the rear remains of the passenger rear wheel area.

98. FD photo 98 showing the driver's side of the EXT.

99. FD photo 99 showing the driver's side rear corner of the EXT and the gas door.

100. FD photo 100 showing the gas door area of the EXT.

101. FD photo 101 showing the damage to the service entrance and to the PVC conduit bring the electrical service in to the service entrance. Photo also showing the damage to the brick work caused by the fire on the ground.

102. FD photo 102 showing the electrical service entrance with the arc gauge and thermal patterns from the bottom up.

103. FD photo 103 showing the fire damage around the electrical service entrance.

104. FD photo 104 showing the fire damage above the brick ledge.

105. FD photo 105 showing the front of the electrical service entrance with exterior fire damage.

106. FD photo 106 showing the damage to the electrical conductors inside the electrical service entrance.

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107. FD photo 107 showing the damage to the conductor in the electrical service entrance.

108. FD photo 108 showing inside the bottom of the electrical service entrance.

109. FD photo 109 showing the locking ring around the wiring going into the electrical distribution panel.

110. FD photo 110 showing damage inside the electrical service entrance.

111. FD photo 111showing damage to the wiring that arced to the cover of the electrical service entrance.

112. FD photo 112 showing damage to the wiring that arced to the cover of the electrical service entrance.

113. FD photo 113 showing the fire damage and arc damage inside the cover to the electrical service entrance.

114. FD photo 114 showing the electrical distribution panel fell before the door to the water heater closet.

115. FD photo 115 showing second view of the electrical distribution panel being under the door to the water heater closet.

116. FD photo 116 showing a better view of the water heater closet door and the location of the electrical distribution panel.

117. FD photo 117 showing the remains of sheet rock (gypsum board) on the lower front of the water heater closet.

118. FD photo 118 showing damage to the trim on the north side of the door opening

119. FD photo 119 showing the fire damage to the framing members above the water heater closet door.

120. FD photo 120 showing the electrical service going to the electrical panel and other branch circuits.

121. FD photo 121 showing the door into apartment.

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122. FD photo 122 showing part of the interior of the apartment.

123. FD photo 123 showing part of the interior of the apartment.

124. FD photo 124 showing part of the interior of the apartment.

125. FD photo 125 showing part of the interior of the apartment.

126. FD photo 126 showing part of the interior of the apartment.

127. FD photo 127 showing part of the interior of the apartment.

128. FD photo 128 showing part of the interior of the apartment.

129. FD photo 129 showing part of the interior of the apartment.

130. FD photo 130 showing part of the interior of the apartment

131. FD photo 131 showing part of the interior of the apartment.

132. FD photo 132 showing part of the interior of the apartment.

133. FD photo 133 showing part of the interior of the apartment.

134. FD photo 134 showing part of the interior of the apartment.

135. FD photo 135 showing part of the interior of the apartment.

136. FD photo 136 showing part of the interior of the apartment.

137. FD photo 137 showing part of the interior of the apartment.

138. FD photo 138 showing part of the interior of the apartment.

139. FD photo 139 showing part of the interior of the apartment.

140. FD photo 140 showing part of the interior of the apartment.

141. FD photo 141 showing the door to the water heater closet removed from the EDP.

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142. FD photo 142 showing the electrical distribution panel standing back in place.

143. FD photo 143 showing breakers in the electrical distribution panel standing back in place.

144. FD photo 144 showing the main breaker and upper part of the panel back in its pre-fire location.

145. FD photo 145 showing the breakers in the bottom of the EDP with thermal damage.

146. FD photo 146 showing the breakers in the upper part of the EDP with greater damage than the breakers below.

147. FD photo 147 showing the remains of the main breaker in the EDP.

148. FD photo 148 showing the damage to the breakers in the EDP.

149. FD photo 149 showing the damage to breakers in the EDP.

150. FD photo 150 showing the damage to breakers in the EDP.

151. FD photo 151 showing the damage to breakers in the EDP.

152. FD photo 152 showing the damage to door of the EDP.

153. FD photo 153 showing the damage to door of the EDP.

154. FD photo 154 showing the fire damage to the EDP.

155. FD photo 155 showing the fire damage to the EDP.

156. FD photo 156 showing the damage to door of the EDP.

157. FD photo 157 showing the door of the EDP.

158. FD photo 158 showing the hinge on the EDP door.

159. FD Photo 159 showing the supply conductor to the EDP.

160. FD photo 160 showing the supply conductor to the EDP.

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161. FD photo 161 showing the remains of insulation in the area around where the electrical service enters the EDP.

162. FD photo 162 showing the damage in the area where the EDP was located pre-fire.

163. FD photo 163 showing the fire spreading between the north wall of the apartment and north wall of the building.

164. FD photo 164 showing the directional patterns and fire spread into the upper part of the apartment.

165. FD photo 165 showing the RV outlet.

166. FD photo 166 showing inside the RV outlet box.

167. FD photo 167 showing the RV outlet.

168. FD photo 168 showing inside the RV outlet box.

169. FD photo 169 showing a J-box mounted to the west wall that contained an outlet prior to the fire.

170. FD photo 170 similar picture to 169.

171. FD photo 171 similar picture to 169.

172. FD photo 172 showing the 4 wires with pins remains of an electrical cord.

173. FD photo 173 showing the four conductors of a 50-amp cord.

174. FD photo 174 showing fire debris with some wiring in it.

175. FD photo 175 showing fire debris with some wiring as in 174.

176. FD photo 176 believed to be in the engine area.

177. FD photo 177 showing the area of the front of the bedroom driver's side.

178. FD photo 178 unknown area of the coach.

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179. FD photo 179 showing remains of an electronic item.

180. FD photo 180 showing the fire spread up and across the top of the water heater closet.

PHOTO NO. SOS PHOTO DESCRIPTION

1. Photo 1 showing the south end of the building.

2. Photo 2 showing the fire damage above the two rollup doors on the south end of the building.

3. Photos 3-4 showing the fire damage to the west side of the building from near the southwest corner of the building.

4. Photo 6 showing the north end of the building from the north-west corner of the building and the attached exterior storage area.

5. Photo 7 showing the north end of the building.

6. Photo 8 showing a view of the building from the northeast corner of the building.

7. Photo 9 showing the east side of the building and the damage to the roof.

8. Photo 10 showing the building from the southeast corner of the building.

9. Photos 11 & 12 showing the fire venting through an east facing window that is exposed to the open areas of the interior of the building.

10. Photo 13 showing no venting from the window for the northeast corner of the apartment.

11. Photos 14-16 stitched together showing the south end of the building from the east side entry door and progressing northward.

12. Photo 18 showing the south facing wall of the apartment in the northeast corner of the building.

13. Photo 20 showing the roof above the apartment the damage to the framing members of the south wall.

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14. Photo 21 showing a wider view of the north end of the bottom of the roof.

15. Photo 22 showing the middle of the roof of the building from the east entry of the building.

16. Photo 24 showing the southeast corner of the roof.

17. Photo 28 showing the interior of the east wall of the building including the entry door.

18. Photos 29-30 stitched facing north from the south wall showing the apartment area and the two roll up doors and two Cadillacs location.

19. Photo 32 showing the Cadillac Escalade in the foreground and the RV between the west wall and the Escalade.

20. Photos 38-41 stitched showing the views from the west side of the west roll up door on the south end of the building.

21. Photo 42 showing the area between the driver's side of the RV and the west wall facing north.

22. Photo 46 showing items located along the west wall forward of the RV.

23. Photo 47 showing the area between the west wall and the front of the coach facing south.

24. Photo 48 showing the front of the RV and facing south showing a wider view of the south end of the interior of the building.

25. Photo 49 showing the rack storage.

26. Photo 50 showing the propane bottles stored on the rack storage.

27. Photo 51 showing the area past the north storage rack.

28. Photo 56 showing the remains of the four-wheeler.

29. Photos 59 and 64 showing the deflection in the beam above the RV, which reflects the amount of heat generated by the RV once it became fully involved in the fire. Note:

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steel will begin to lose strength at 800°F. allowing the deflection to occur.

30. Photo 67 showing the west facing wall of the apartment and the passenger side rear half of the Cadillac EXT and the east roll up door.

31. Photo 69 showing the passenger side wall of the RV fell toward the east side of the building onto the floor of the building.

32. Photos 70 - 73 showing the front of the Escalade moving clockwise around the vehicle.

33. Photos 74 – 77 continuing clockwise around the Escalade.

34. Photos 78 – 87 showing the interior of the passenger compartment of the Escalade.

35. Photo 88 the south facing side of the apartment.

36. Photos 90-91 showing west side of the apartment and the water heater closet with the door on the ground in front of it. Fire spread patterns from the north wall moving south are visible.

37. Photo 92 showing the location of the electrical distribution equipment and the level of where the supply came through the wall.

38. Photos 92-94 stitched together showing northwest corner of the apartment.

39. Photos 95-96 stitched together showing the top of the west wall of the apartment with fire spread patterns indicating the fire was spreading from the north end of the west wall toward the south end of the wall.

40. Photo 98 showing the area from the east end of the east door on the north end of the building and the exterior wall of the apartment.

41. Photo 99 showing the fire spread from west to east in the north wall.

42. Photo 101 showing the fire spread from west to east in the northeast part of the north wall.

43. Photos 101-102 stitched showing the northeast part of the north wall.

44. Photo 103 showing the electrical entrance panel with evidence of an arc hit on the panel

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cover.

45. Photo 105 showing a closer view of the arc hit on the entrance cover.

46. Photos 106-108 showing the engine compartment of the Escalade with melting patterns indicating greater damage on the driver's side of the compartment consistent with the fuel load provided by the RV.

47. Photo 139 showing the remains of the battery of the Escalade and an arc hit on the battery cable.

48. Photo 139 annotated showing the arc hit on the Escalade with a red circle.

49. Photos 147 and 148 showing the passenger side of the Cadillac EXT.

50. Photo 153 showing the damage to the driver's side of the Cadillac EXT with greater damage from the driver's rear door to tailgate.

51. Photo 155 showing the area of the water heater.

52. Photo 161 showing the electrical distribution panel.

53. Photo 167 showing the remains of the melted windshield glass on top of the dash. This indicates the fire attacked the glass at the top causing it release from the top and collapse into the passenger compartment falling across the top of the dash.

54. Photos 169 and 169 annotated, showing the area at the intersection of the west exterior wall of the apartment and the north wall of the building near the electrical service entrance and the fire damage patterns indicating the fire spread from the panel attacking the wall of the apartment. The red arrow shows the directional pattern and the charring on the on the north end of the west wall of the apartment.

55. Photo 171 showing the south facing section of the wall at the south end of the west facing wall with greater damage than the south facing section of the wall that connects to the east wall of the building.

56. Photo 172 showing the top of the two south facing sections of the wall of the apartment and the damage spreading from west to east.

57. Photo 173 showing the outside of the apartment was finished with sheet rock.

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58. Photos 177, 181, 185 and 186 showing the interior of the apartment with fire attacking the top of the apartment as the thermal layer descended toward the floor.

59. Photos 215 showing the breach in the wall behind the stove and in the corner created by the different lines in the south facing exterior wall. Fire damage is outside in.

60. Photo 219 showing the remains of the four-wheeler located along the west wall between the front of the coach and the north wall.

61. Photos 221, 226, 228 showing the driver's side of the coach and the area between the coach and the west wall.

62. Photos 225 and 230 showing the propane tank on the coach with evidence the tank vented during the fire, which would have added to the damage to the wall around the tank.

63. Photo 254 showing the remains of the rear cap of the coach with greater damage to the passenger side.

64. Photos 255-256 showing the debris along the passenger side of the coach from the rear of the coach.

65. Photos 258, 261, 262 showing the driver's side of the coach before the excavation of the area.

66. Photo 263 showing the ceiling heater that had fallen to the floor along the west wall.

67. Photo 265 showing the remains of the RV outlet.

68. Photo 266 showing the four-wire RV extension cord with the ceiling heater having fallen on top of the cord.

69. Photos 268-271 showing wiring inside the RV outlet.

70. Photo 273 showing the breakers in the electrical panel of the coach with the breakers mostly intact.

71. Photos 276 and 279-280 showing the remains of the coils in the rear roof top air conditioner of the coach.

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72. Photo 278 showing the copper wiring routed along the frame of the chassis of the coach.

73. Photo 282 showing the remains of the coach looking forward toward the front of the coach.

74. Photo 284 showing the location of the panel from the coach, the extension cord that was connected to the RV outlet and the ceiling heater that had fallen to the floor during the fire and the spare propane bottles that were stored on the rack storage along the west wall.

75. Photo 284 annotated.

76. Photos 290-294 showing the house battery bank.

77. Photo 306 showing the location of the Dometic freezer box located on the passenger side of the coach under the living room part of the coach with the fuel tank inbound from freezer.

78. Photo 307 showing the remains of the flooring just aft of the fuel tank on the coach

79. Photos 308 and 309 showing the remains of combustibles in the coach and the remains of the front air conditioner unit and their relationship to the sofa on the passenger side of the living room and the air conditioner with coils still present.

80. Photos 313-314 showing the remains of the front air conditioner with most of the coils still in place.

81. Photo 316 showing the top of the hood and the top of the dash with the windshield glass of the Cadillac EXT being melted across the top of the dash.

82. Photos 317 and 318 showing the engine compartment and the bottom of the hood that was not burned clean.

83. Photo 321 showing the remains of the hood liner on top of the engine.

84. Photo 328 showing the windshield glass melted across the top of the dash.

85. Photos 336 and 338 showing the location of the refrigerator and evidence showing the cooling unit was struck by one of the ceiling heaters falling on the refrigerator.

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86. Photo 343 showing the cooling unit folded into the frame of the coach by the falling ceiling heater.

87. Photo 426 showing the main breaker and the front of the electrical distribution panel (EDP).

88. Photo 427 showing the branch circuit breakers in the EDP.

89. Photo 429 showing the EDP from the branch breakers to the bottom of the panel.

90. Photo 430 showing the left side of the EDP with circuits routed beside the panel but none entering the side of the panel.

91. Photo 431 showing the side of the panel and the whole in the wall through which the electrical feed wires entered the building. Note no evidence of a metallic nipple between the service entrance and the EDP.

92. Photo 433 showing the top of the EDP and the branch circuits leaving the panel.

93. Photo 434 showing openings in the top rear of the panel for circuits leaving the EDP.

94. Photo 435 showing the lower part of the rear of the EDP.

95. Photo 437 showing the lowest parts of the rear of the EDP.

96. Photo 438 showing a closer view of the hole through which the electrical service feed entered the building. The photo shows the service entrance, and the panel were only separated by the metal skin of the building.

97. Photo 439 showing the electrical feed and the wiring entering the EDP.

98. Photo 440 showing the wiring routed over the edge of the purlins and across other surfaces.

99. Photo 446 showing the routing of the electrical feed to the apartment. The photo also shows the directional patterns indicating fire spread from north to south in this area.

100. Photo 447 showing the fire spreading between the metal building wall and the apartment.

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101. Photos 535 – 548 shows the interior of the west wall after the interior panels were removed. (Individual photos in succession)

102. Photo 614 showing east side of the building and the damage to the roof and the deformation of the roof.

103. Photo 618 showing the location of the male pins in relation to the cord storage compartment and its door.

104. Photo 621 annotated showing the cord coming out of the compartment and the location of the male pins.

105. Photo 622 showing the male ground pin from the coaches attached shore cord.

106. Photo 627 showing the two male pin from the coaches attached shore cord.

107. Photo 629 showing the location of all four male pins of the coaches attached shore cord.

108. Photo 630 showing the conductors of the shore cord in the debris just outside the compartment.

109. Photo 631 annotated showing the wiring with the red arrows.

110. Photo 633 showing the location of the four male pins.

111. Photo 646 showing the process of marking and tracing the electrical circuits in the building.

112. Photo 647 showing the process of marking and tracing the electrical circuits in the building.

113. Photo 651 showing that chaff protection was used in some of the holes drilled in the purlins. The metal ring below the yellow tape is to secure the PVC conduit in the hole.

114. Photo 669 showing the male pins from the coach's shore cord after removal and collection.

115. Photo 670 showing a closer view of the male pins of the shore cord.

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116. Photo 673 showing the flexible power cord for a powered speaker mounted in the northwest corner of the building near the top of the roll up door.

117. Photo 679 showing the notch in the door frame of the chord compartment to allow the cord to exit with the door closed.

118. Photo 680 annotated showing the notch in the frame of the door opening to the chord compartment.

119. Photo 688 showing a view looking down from the area above the EDP.

120. Photo 692 showing the wiring as run across the top of the north wall doors.

121. Photo 713 showing the remains of the master battery switch on the RV. The switch is in the on position

122. Photo 725 showing the input and output cables on the master battery switch.

123. Photo 728 -729 showing the location of the battery storage area. The cranking batteries are at the rear of the tray and the house batteries are in the front two thirds of the tray.

124. Photo 733 showing the wiring associated with the house battery bank of six-volt batteries.

125. Photos 745-773 showing the tracing of the 12 VDC circuit showing there was no evidence of electrical activity past the "store switch".

126. Photo 776 showing the remains of the front air conditioner unit.

127. Photos 779 and 781 showing the remains of the Dometic electric ice chest.

128. Photos 814-816 showing a location of copper damage on a conductor near the EDP. This was examined in the lab examine and excluded as evidence of electrical arcing.

Photographs 819-1016 are of the November 2021 examination of the two Cadillac vehicles that were damaged in the fire. These pictures will be submitted with the report as digital images. The examination of the vehicles found nothing of evidentiary value that had not been documented during the examination.

The conclusions and opinions stated herein are based on work and evidence reviewed to date.

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Should further evidence develop indicating a need for continued analysis, we reserve the right to expand or modify our opinion as dictated by such developments.

Walter L. Oliveaux, C.F.E.I.
President / Chief Investigator

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ATTACHMENT SUMMARY

ATTACHMENT NO.	ATTACHMENT DESCRIPTION
1.	SOS Photos with Report (Power Point & PDF)
2.	Edmond Fire Department Photos (Power Point & PDF)
3.	Walter L. Oliveaux, CFEI CV.
4.	SOS Rate Schedules for the various examinations.
5.	SOS Invoices for job 2018-129-C.
6.	Owner's manual for the RV.
7.	Diagram showing the location of fire origin.
8.	Diagram of the fire loss showing the evidence collection locations – Building wiring.
9.	Diagram of Area of Fire Origin – Fire Spread patterns

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